detected even right beside the berg. I took a number of samples of sea water at different distances from the icebergs, as well as samples taken far from ice. These samples I carefully bottled and brought home to the laboratory, where they were most accurately tested for me by the electric conductivity method in the physico-chemical department by Dr. McIntosh and Mr. Otto Maass. No possible error could result in this way, and the tests being carried out at a constant temperature under the most favorable conditions, there is no reason to doubt their correctness. The comparison shows no dilution due to the icebergs, which goes to show how quickly the melted water from the berg is mixed with the sea water. Larger variations were found at different parts of the sea than were obtained in the proximity of ice.

It is evident that an iceberg in melting produces only two of the Pettersson currents, i. e., a cold current which sinks downward carrying with it all the melted ice water, and a horizontal surface current of sea water flowing in toward the ice to cause its melting. By this means we should expect the sea in the immediate proximity of icebergs to be warmer than farther away, because the sea surface current is moving inward to the berg and does not share in the normal vertical circulation which tends to keep the sea surface temperature cooler.

An iceberg in causing its own current of warmer water provides for its own disintegration. Abundant evidence is at hand to show the melting process going on under the water line.

In my observations of icebergs I was greatly struck with the large amount of air dissolved in the ice. The white color of the berg is due to innumerable air bubbles in the ice, and not to snow on the surface. An iceberg is very deceptive in this way. While it looks quite soft, the ice is so hard as to make it difficult to chop it with an axe. Ice water which I prepared for drinking on board ship with iceberg ice appeared to effervesce like soda water, merely due to the liberation of the air from the melting ice. It is possible that the sudden disappearance of bergs with a loud report is due to their explosion from accumulated air in their interior. I passed close to one berg which was casting off small pieces, apparently by the pressure of the pent-up air.

While icebergs send the temperature of the sea up, land and the coast line send it down. This was observed all along the coast in the Straits of Belle Isle. This effect is due to the action of the land in turning up the colder underwater by the action of tides and currents. A great deal of work remains to be done in studying the effect of land and shoals on the temperature of the sea, but observations show the effect not only here, but on the Irish and English coasts.

From the point of view of the safety of the St. Lawrence route the effect of land is most important. The iceberg causes us little worry because we have only a very short ice track, but to find means whereby the proximity of land can be determined is of the greatest importance.

FRAZIL AND ANCHOR ICE DISSIPATED BY A SIMPLE REMEDY.

The importance of keeping water and turbine wheels free from ice, so that work may not be interrupted in large factories, has led Dr. Howard T. Barnes, professor of physics at McGill University, Montreal, Canada, to study the method of formation of frazil and anchor ice with the view to finding some remedy for the many annoyances that it causes in the cold winters of Canada (and to a less degree in many parts of the United States). It has long been recognized that the rising sun brings speedy relief to hydraulic plants that are frozen up with frazil. Experience had also shown that water wheels protected by wooden racks were better able to withstand frazil than those protected by iron racks. The fact is that the water when just at the freezing point needs only to be cooled the hundredth or the thousandth part of a degree Fahrenheit in order to turn into hard ice and that, too, in a very few minutes. Vice versa, when machinery is frozen up in frazil the latter will quickly turn back to water by the application of a little heat in the form of steam if properly turned on. By waiting several hours the ice may become as hard as stone, but the prompt application of steam will work marvels.

The St. Lawrence River water remains just at the freezing point nearly all winter wherever it is flowing rapidly, but it makes frazil in quiet places and after sunset, or above such a waterfall as Lachine Rapids. On the other hand, warmth of sunlight or the warmth produced by descending rapids is sufficient to dissipate the frazil, although the change in temperature is only a few thousandths of a degree. A very small boiler of water and a ton of coal will generate enough steam, if led by pipe to the water that is about to enter a turbine, to give the water the slight additional warmth necessary to protect it from frazil.

Mr. John Murphy, engineer of the Ottawa Electric Railway Co., says that they have had no trouble with frazil since applying this remedy in 1907. Of course many special patents have been issued relative to this new idea of warming the water to prevent frazil and anchor ice being formed in the cold water. The economy consists in the fact that by prompt action we prevent the formation, rather than wait a few hours until the ice becomes very hard, cold, and thick, therefore requiring an almost impracticable amount of heat. It is only during the few seconds required by the water to flow through the turbine or over the wheel that we need to heat the liquid and prevent the ice. C. A.

THE STORMS OF NOVEMBER IN JAMAICA, WEST INDIES.

The Hon. Maxwell Hall, Esq., of Montego Bay, well known as one of the most learned men of the West Indies, and as an active astronomer, jurist, and meteorologist, the founder and director of the present system of meteorology on that island, has sent us a preliminary report on the storms and hurricanes of November, 1912, from which we make only the following abstracts, as he hopes to prepare a full report, with maps, showing the condition of the atmosphere for every two hours during the progress of the storms.

In connection with the worst of the hurricane which was at 6 p. m., November 18, at Kempshot, he asys:

> There was a most brilliant yellow light all over the confused sky and all around the horizon; it changed to orange, then to red, then clouded over with dark squalls, and suddenly the northwest hurricane of 120 miles per hour was down upon us. The light was seen all over the west end of the island and caused some alarm. At Falmouth it was seen at nighttime. When I first saw it we were just emerging from the central calm area 20 miles in diameter.

In his general account of the three several storms of the month, Mr. Hall says:

> Heavy rains fell over the northeastern part of the island in the shires of St. Thomas, Portland, St. Andrew, and St. Mary, on the 10th, 11th, and 12th of November, 1912. On these three days 34 inches fell at Rose Hill near Hardware Gap in St. Andrew's Parish, and 36 inches fell in Moy Hall near Cedar Valley in St. Thomas Parish. These rains produced

floods which damaged the roads and caused a large landslide at Vaughans Rock near Castleton, where four or five acres of land moved downwards and partly blocked the wagwater. The high northerly winds which accompanied the rains blew down very many banana trees.

These winds and rains were produced by a large and shallow barometric depression which was then south of the east end of the island, moving leisurely westward. On the 13th it was south of the middle of the island, and the fall of the barometer at Kingston was about a tenth and a half of an inch. On the 14th its presence was felt at the Kempshot Observatory and at the Negril Point Lighthouse; and on the 15th and 16th its position south of Negril was well marked.

We must now return to Kingston. The break-up of a long-continued drought occurred on the afternoon of the 10th, with a heavy thunderstorm which lasted through the night, and rains fell during the passage of the southern depression. On the afternoon of the 14th the barometer began to rise, but between 7 a. m., and 3 p. m., the air currents at Kingston swung round to the south; this was well marked at the Weather Office, Halfway Tree, and a slight fall in the barometer showed that another depression was forming, this time in the middle of the island. But still the combined fall of the barometer was only a tenth and a half below the mean, and both the disturbances were only cases of our usual "depressions," which are so beneficial when not too strongly marked by heavy rains and stormy weather.

On the afternoon of the 15th the barometer in Kingston fell to 29.74, and the wind from the southeast rose to 20 miles an hour. At Kempshot the barometer was higher, namely 29.77 inches, with a light east wind; and this showed that the inland depression was felt more in Kingston than at Kempshot.

During these days telegraphic messages had been passing between Kingston and Kempshot, but the latter place is isolated and much time was lost; moreover, the inland depression confused the indications. These had already been confused at Kempshot by a storm or depression far away to the west or northwest.

On the 16th at 7 a. m. the barometer at Negril was 29.63, wind northeast, 12 miles an hour; at Kempshot it was 29.70, wind east, 4 miles an hour, so that up to this time there was no cause for apprehension, but at 11 a. m. it was noticed at Kempshot that the center of the Negril disturbance was turning northward and a telegram was at once sent to Kingston to warn the west end of the island. In the meantime the interior disturbance had broken the telegraphic communication in the middle of the island and the wires were still down on Sunday, the 17th, when I wished to inform Kingston that the center was then off the northwest end of the island, but the west end had received the general storm warnings from Kingston and they were posted at all the telegraph offices. Each hurricane season the public are advised to take every precaution after such warnings have been issued, for the telegraph wires may be broken, or two cyclones, or the curvature of a single cyclone in its course, may confuse the indications; all of which occurred at this time.

Referring to the map that will accompany the full report, the advancing cyclone "B" was strongly felt at Negril, but it was not until midnight of the 17th–18th that at Kempshot I became aware that there were two cyclones. Some lower clouds were moving from the southeast to cyclone A, and some were moving from the east to cyclone B, producing the wildest confusion in the sky dimly lit by moonlight.

Cyclone B arrived at St. Johns Point at 8 a. m., and from the duration of the calm at the lighthouse and its rate of motion it may be deduced that the diameter of the calm area was about 20 miles. Again, it passed centrally over Windsor Pen in Trelawny at 6 p. m., so that the center was moving at the rate of 4.7 miles per hour; and as the calm area took four hours to pass over Windsor, the diameter of the calm area was about 19 miles, which agrees very closely with the diameter found at Negril.

But while the barometer at Negril fell to 28.49, at Windsor it fell to only 29.32; so that the passage of cyclone B over the island, and also its encounter with cyclone A, had greatly reduced its intensity; so much so that on its onward course it did comparatively little damage.

Having given a general description of cyclone B we must now return to cyclone A which had greatly increased in intensity during the night of the 17th and early morning of the 18th. It wrecked the west end of the island and the town of Lucea shortly after midnight, and the center passed a little south of Great Valley in Hanover at 2.30 a. m. At midnight the wind at Great Valley blew with hurricane force from the southeast; at 5 a. m., the wind backed to the northeast with increased violence, but nothing is said about a calm in this interval, so that probably the diameter of the calm area was small.

The center of cyclone A was moving very slowly at about 3 miles an hour, and it was approaching Kempshot where the barometer slowly fell until 4.55 a. m. It was then 29.24, wind southeast, in violent gusts. Then the barometer began to rise slowly, so that the curve on its course carried the center nearest to Kempshot when the center passed over the Bogue Islands a little west of Montego Bay.

The barometer at Kempshot began to fall again at 6 a. m., to the advancing cyclone B with the wind east southeast or southeast.

Great Valley seems to have had little wind between 10 a. m., and 2 p. m., it was at first protected by its position between the two centers, and then it was in the large calm area of cyclone B. But at 2 p. m., the calm area had passed and the wind blew from the north with appalling violence.

At Kempshot, between 6 a. m. and noon, the wind veered from southeast to south-southeast and south, when it blew a hurricane until 1.20 p. m. This was due to an erratic approach of cyclone A. At 1.30 p. m., there was a lull, due to the calm area of cyclone B, but as Kempshot was on the edge of the calm area of cyclone A, the two calm areas may have united. At least there was the appearance in the sky of a calm area for many miles to the southwest, and also to the north, with patches of blue sky here and there.

The calm continued until 6 p. m., when the wind blew from the northwest with terrific force. Kempshot was then just outside the calm area, and this shows that the computed velocity of the center, its direction, and the diameter of the calm area, are as correct as possible.

I know but little of the further progress of this storm; at Windsor the wind blew with hurricane force from the southeast up to 4 p. m.; then came the calm, and afterwards at 8.05 p. m., the wind blew with hurricane force from the northwest. The steamship *Admiral Dewey* ran into it off St. Anns Bay that night, and it was finally reported to have taken the Windward Passage.

The conflict of the two cyclones from noon to 2 p. m., between Montego Bay and Kempshot will require much careful study. I have a most valuable series of notes from Cinnamon Hill, between Montego Bay and Falmouth, consisting of barometer readings and directions of the wind; but as Mr. Shore remarks, "at times it came from all sides—a strong gust from the north being followed by one from the east and south." I have not been able to use his notes in this preliminary report. It appears, however, that after cyclone B had passed eastward another cyclone (either A or C) passed westward, giving Cinnamon Hill and Kempshot northeast and east winds in squalls and gusts

JAMAICA, *December 2, 1912.*

A ST. LAWRENCE RIVER MIRAGE

[By Mr. DOUGLAS MANNING, Alexandria Bay, N. Y.]

A peculiar and interesting mirage occurs on the St. Lawrence River, and is seen during the spring and autumn months from the village of Alexandria Bay, N. Y., when cloudy skies prevail, and soon after northerly winds have set in and the weather is growing colder and "on the clear."

Looking northward from the village are several small islands, about 2 miles away, situated near the center of the river, which make a very pretty picture, covered with pine and cedar, and surrounded by the water, characteristically so blue. When such weather conditions prevail as mentioned above, these islands appear as though they were situated on a snow-covered ice field with the trees standing out in strong relief, giving the appearance of a dead calm prevailing in the immediate section. The effect is totally weird, for in reality the wind is strong and the water quite rough, for north winds blow against the river current.

The most interesting feature is that if one ascends a nearby bluff about 25 feet high, the illusion disappears entirely, and the islands, surrounded by the rough, blue waters, and the trees take on their natural look. Residents predict colder, clearing weather whenever the mirage appears, and of course it is a very good sign.

NOTE.

It will soon be proper to prepare a corrected and enlarged edition of the "Chronological Outline" published in the Monthly Weather Review in 1909, volume 37, pages 87–180. All observers and correspondents of the Weather Bureau are urgently requested to send Prof. Abbe of this bureau, such corrections, additions, and suggestions, as may be appropriate to this new edition.